PS9306L,PS9306L2

R08DS0017EJ0100
Rev.1.00
Nov 10, 2011

0.6 A OUTPUT CURRENT, HIGH CMR, IGBT GATE DRIVE, 6-PIN SDIP PHOTOCOUPLER

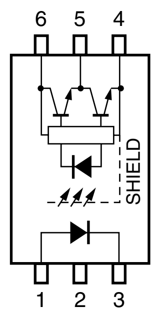
DESCRIPTION

The PS9306L and PS9306L2 are optical coupled isolators containing a GaAlAs LED on the input side and a photo diode, a signal processing circuit and a power output transistor on the output side on one chip.
The PS9306L and PS9306L2 are in 6-pin plastic SDIP (Shrink Dual In-line Package). The PS9306L2 has 8 mm creepage distance. The mount area of 6-pin plastic SDIP is half size of 8-pin DIP.
The PS9306L and PS9306L2 are designed specifically for high common mode transient immunity (CMR) and high switching speed. It is suitable for driving IGBTs and MOS FETs.
The PS9306L is lead bending type (Gull-wing) for surface mounting.
The PS9306L2 is lead bending type for long creepage distance (Gull-wing) for surface mount.

FEATURES

- Long creepage distance (8 mm MIN.: PS9306L2)
- Half size of 8-pin DIP
- Peak output current (0.6 A MAX., 0.4 A MIN.)
- High speed switching (t_{PLH}, t_{PHL} = 0.4 μs MAX.)
- High common mode transient immunity (CM_H, CM_L = ±25 kV/μs MIN.)
- Embossed tape product : PS9306L-E3, PS9306L2-E3: 2 000 pcs/reel
- Pb-Free product
- <R> Safety standards
  - UL approved: No. E72422
  - CSA approved: No. CA 101391 (CA5A, CAN/CSA-C22.2 60065, 60950)
  - SEMKO approved: No. 1115598
  - DIN EN60747-5-2 (VDE0884 Part2) approved: No. 40024069 (Option)

PIN CONNECTION
(Top View)



1. Anode
2. NC
3. Cathode
4. V_{EE}
5. V_O
6. V_{CC}

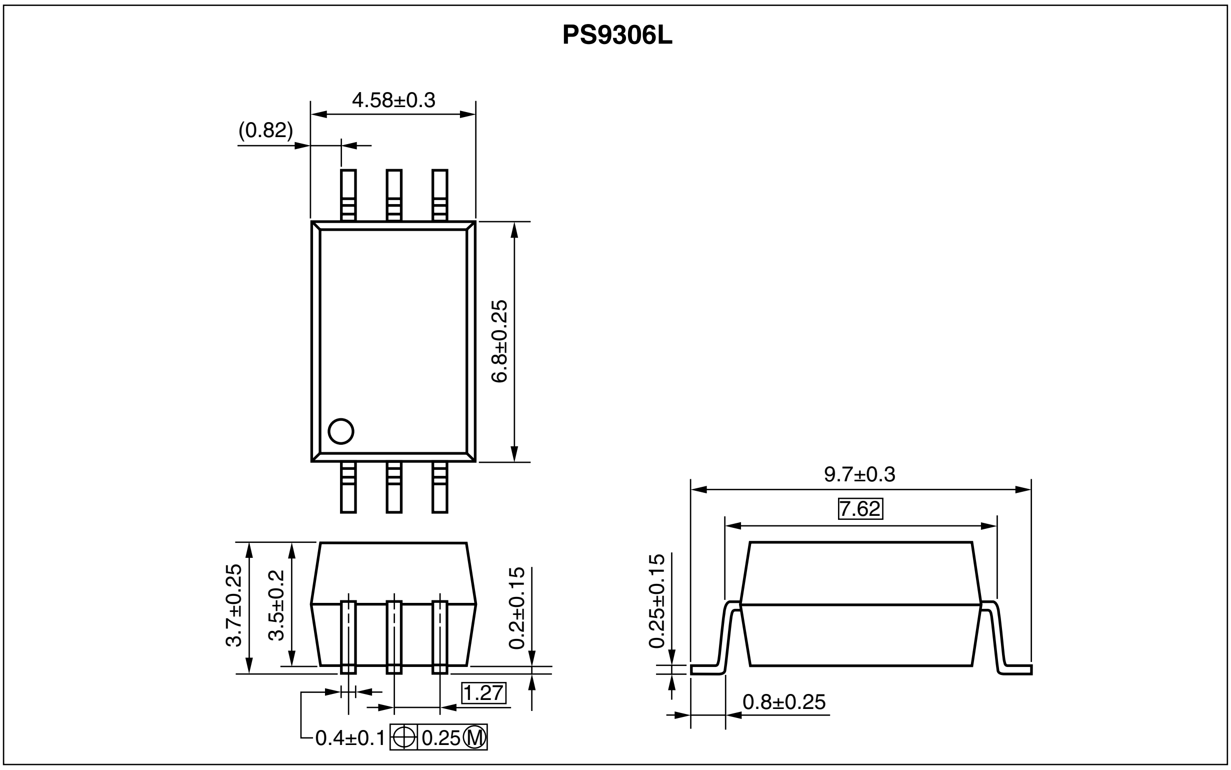
APPLICATIONS

- IGBT, Power MOS FET Gate Driver
- Industrial inverter
- IH (Induction Heating)

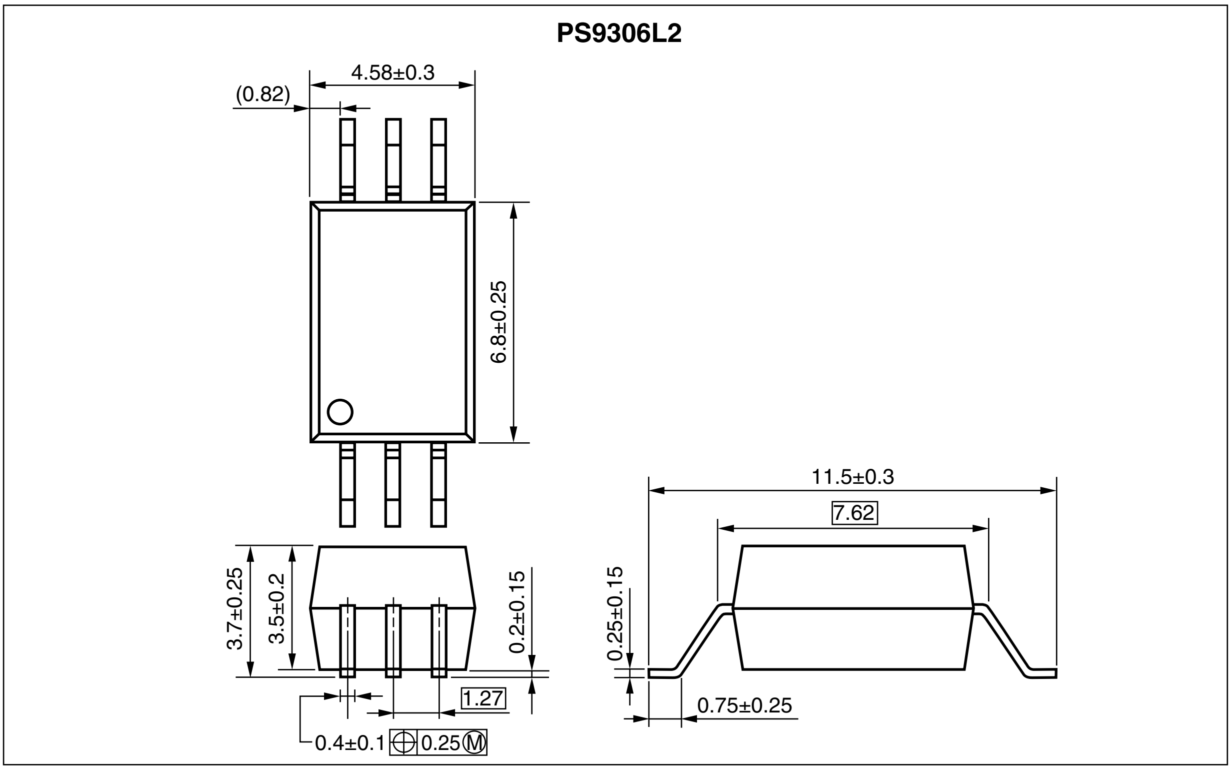
The mark <R> shows major revised points.
The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.

PACKAGE DIMENSIONS (UNIT: mm)

Lead Bending Type (Gull-wing) For Surface Mount



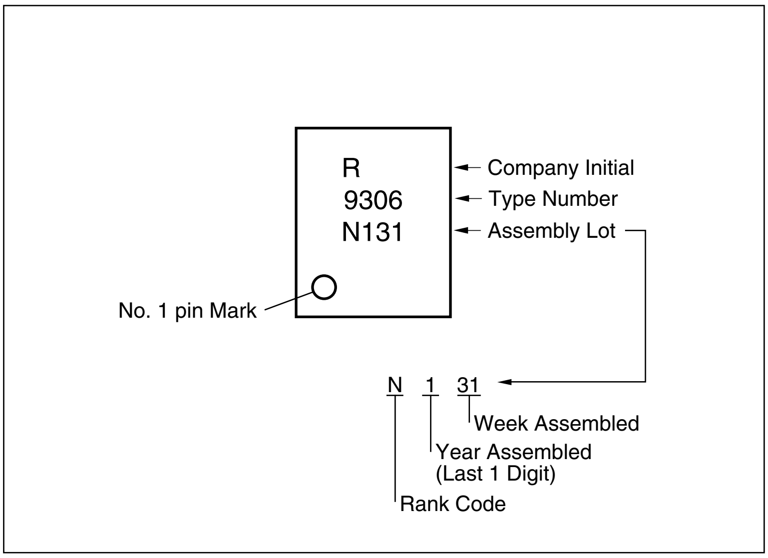
Lead Bending Type (Gull-wing) For Long Creepage Distance (Surface Mount)



PHOTOCOUPLER CONSTRUCTION

Parameter	PS9306L	PS9306L2
Air Distance (MIN.)	7 mm	8 mm
Outer Creepage Distance (MIN.)	7 mm	8 mm
Isolation Distance (MIN.)	0.4 mm	0.4 mm

<R>
MARKING EXAMPLE



<R>
ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number*1
PS9306L	PS9306L-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA, SEMKO approved)	PS9306L
PS9306L-E3	PS9306L-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9306L2	PS9306L2-AX		20 pcs (Tape 20 pcs cut)		PS9306L2
PS9306L2-E3	PS9306L2-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9306L-V	PS9306L-V-AX		20 pcs (Tape 20 pcs cut)	DIN EN60747-5-2 (VDE0884 Part2) approved (Option)	PS9306L
PS9306L-V-E3	PS9306L-V-E3-AX		Embossed Tape 2 000 pcs/reel		
PS9306L2-V	PS9306L2-V-AX		20 pcs (Tape 20 pcs cut)		PS9306L2
PS9306L2-V-E3	PS9306L2-V-E3-AX		Embossed Tape 2 000 pcs/reel		

Note: *1. For the application of the Safety Standard, following part number should be used.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, unless otherwise specified)

Parameter		Symbol	Ratings	Unit
Diode	Forward Current	I_F	25	mA
	Peak Transient Forward Current (Pulse Width < 1 μs)	$I_{F (TRAN)}$	1.0	A
	Reverse Voltage	V_R	5	V
	Power Dissipation *1	P_D	45	mW
Detector	High Level Peak Output Current *2	$I_{OH (PEAK)}$	0.6	A
	Low Level Peak Output Current *2	$I_{OL (PEAK)}$	0.6	A
	Supply Voltage	$(V_{CC}–V_{EE})$	0 to 35	V
	Output Voltage	V_O	0 to V_{CC}	V
	Power Dissipation *3	P_C	250	mW
Isolation Voltage *4		BV	5 000	Vr.m.s.
Operating Frequency *5		f	50	kHz
Operating Ambient Temperature		T_A	–40 to +110	°C
Storage Temperature		T_{stg}	–55 to +125	°C

Notes: *1. Reduced to 1.2 mW/°C at T_A = 85°C or more.

*2. Maximum pulse width = 10 μs, Maximum duty cycle = 0.2%

*3. Reduced to 4.5 mW/°C at T_A = 65°C or more.

*4. AC voltage for 1 minute at T_A = 25°C, RH = 60% between input and output. Pins 1-3 shorted together, 4-6 shorted together.

*5. $I_{OH (PEAK)}$ ≤ 0.4 A (≤ 2.0 μs), $I_{OL (PEAK)}$ ≤ 0.4 A (≤ 2.0 μs)

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	$(V_{CC}–V_{EE})$	10		30	V
Forward Current (ON)	$I_{F (ON)}$	8		12	mA
Forward Voltage (OFF)	$V_{F (OFF)}$	–2		0.8	V
Operating Ambient Temperature	T_A	–40		110	°C

ELECTRICAL CHARACTERISTICS (T_A = –40 to +110°C, V_{CC} = 10 to 30 V, $I_{F\ (ON)}$ = 8 to 12 mA, $V_{F\ (OFF)}$ = –2 to 0.8 V, V_{EE} = GND, unless otherwise specified)

Parameter		Symbol	Conditions	MIN.	TYP.[*1]	MAX.	Unit
Diode	Forward Voltage	V_F	I_F = 10 mA, T_A = 25°C	1.2	1.56	1.8	V
	Reverse Current	I_R	V_R = 3 V, T_A = 25°C			10	μA
	Input Capacitance	C_{IN}	f = 1 MHz, V_F = 0 V, T_A = 25°C		30		pF
Detector	High Level Output Current	I_{OH}	V_O = (V_{CC} – 4 V) [*2]	0.2			A
			V_O = (V_{CC} – 10 V) [*3]	0.4	0.5		
	Low Level Output Current	I_{OL}	V_O = (V_{EE} + 2.5 V) [*2]	0.2	0.4		A
			V_O = (V_{EE} + 10 V) [*3]	0.4	0.5		
	High Level Output Voltage	V_{OH}	I_O = –100 mA [*4]	V_{CC} – 4.0	V_{CC} – 1.8		V
	Low Level Output Voltage	V_{OL}	I_O = 100 mA		0.4	1.0	V
<R>	High Level Supply Current	I_{CCH}	I_F = 10 mA, I_O = 0 mA		0.7	3.0	mA
<R>	Low Level Supply Current	I_{CCL}	I_F = 0 mA, I_O = 0 mA		1.2	3.0	mA
Coupled	Threshold Input Current (L → H)	I_{FLH}	I_O = 0 mA, V_O > 5 V			7.0	mA
	Threshold Input Voltage (H → L)	V_{FHL}	I_O = 0 mA, V_O < 5 V	0.8			V
	Isolation Capacitance	$C_{I\text{-}O}$	V_F = 0 V, f = 1 MHz, T_A = 25°C		0.7		pF

Notes: *1. Typical values at T_A = 25°C, V_{CC} – V_{EE} = 30 V.

*2. Maximum pulse width = 50 μs, Maximum duty cycle = 0.5%.

*3. Maximum pulse width = 10 μs, Maximum duty cycle = 0.2%.

*4. V_{OH} is measured with the DC load current in this testing.

SWITCHING CHARACTERISTICS (T_A = –40 to +110°C, V_{CC} = 10 to 30 V, $I_{F\ (ON)}$ = 8 to 12 mA, $V_{F\ (OFF)}$ = –2 to 0.8 V, V_{EE} = GND, unless otherwise specified)

Parameter	Symbol	Conditions	MIN.	TYP.*1	MAX.	Unit
Propagation Delay Time (L → H)	t_{PLH}	R_g = 47 Ω, C_g = 3 nF,	0.05	0.18	0.4	μs
Propagation Delay Time (H → L)	t_{PHL}	f = 10 kHz,	0.05	0.18	0.4	μs
Pulse Width Distortion (PWD)	$\lvert t_{PHL}-t_{PLH}\rvert$	Duty Cycle = 50%*2,			0.25	μs
Propagation Delay Time (Difference Between Any Two Products)	$t_{PHL}-t_{PLH}$	I_F = 10 mA, V_{CC} = 30 V	–0.3		0.3	μs
Rise Time	t_r			50		ns
Fall Time	t_f			50		ns
Common Mode Transient Immunity at High Level Output	$\lvert CM_H\rvert$	T_A = 25°C, I_F = 10 mA, V_{CC} = 30 V, V_{CM} = 1.5 kV, $V_{O\ (MIN.)}$ = 26 V	25			kV/μs
Common Mode Transient Immunity at Low Level Output	$\lvert CM_L\rvert$	T_A = 25°C, I_F = 0 mA, V_{CC} = 30 V, V_{CM} = 1.5 kV, $V_{O\ (MAX.)}$ = 1 V	25			kV/μs

Notes: *1. Typical values at T_A = 25°C, V_{CC} – V_{EE} = 30 V.

*2. This load condition is equivalent to the IGBT load at 1 200 V/25 A.

TEST CIRCUIT

Fig. 1 I_{OH} Test Circuit

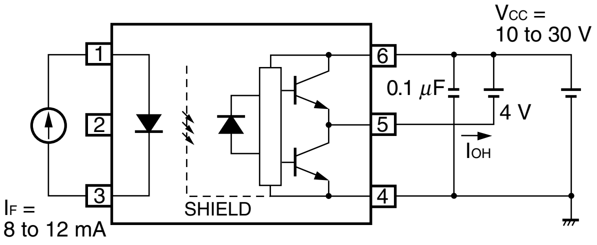


Fig. 2 I_{OL} Test Circuit

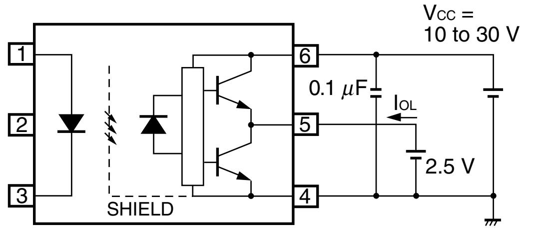


Fig. 3 V_{OH} Test Circuit

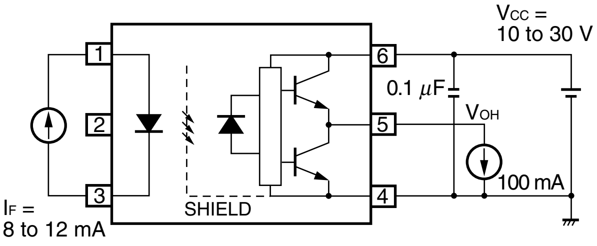
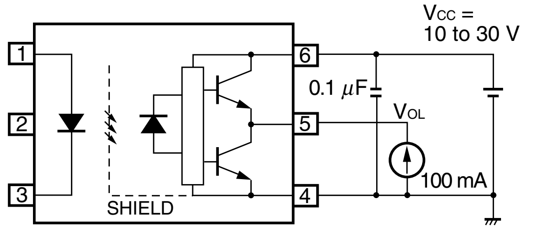


Fig. 4 V_{OL} Test Circuit



<R>

Fig. 5 I_{FLH} Test Circuit

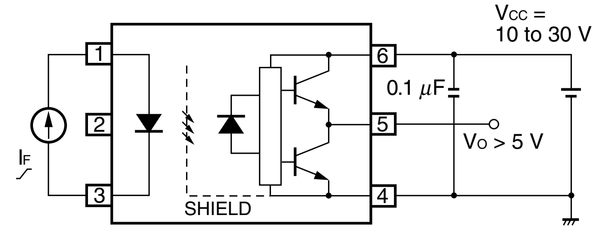
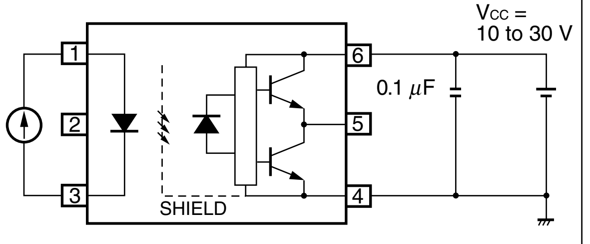


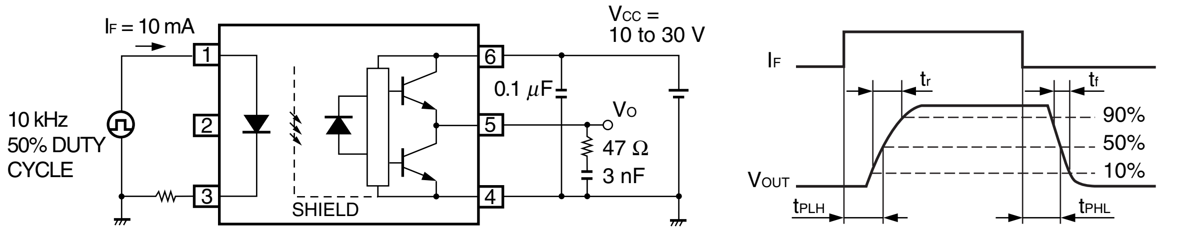
Fig. 6 I_{CCH}/I_{CCL} Test Circuit



I_{CCL}: I_F = 0 mA
I_{CCH}: I_F = 10 mA

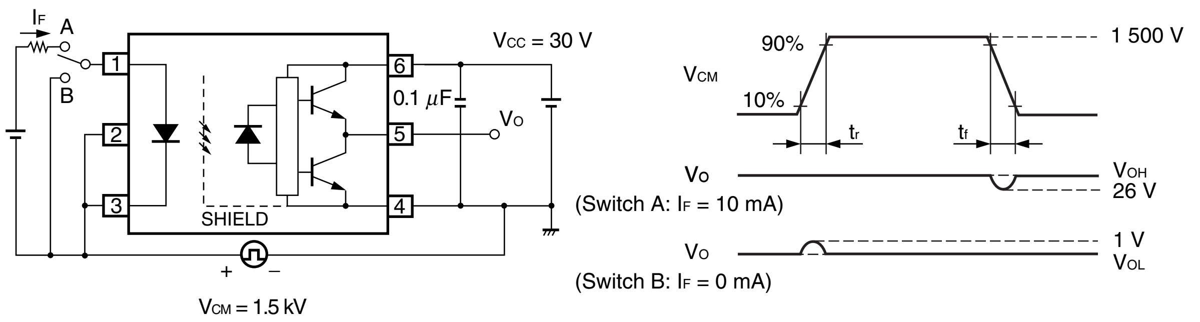
<R>

Fig. 7 tPLH, tPHL, tr, tf Test Circuit and Wave Forms



<R>

Fig. 8 CMR Test Circuit and Wave Forms

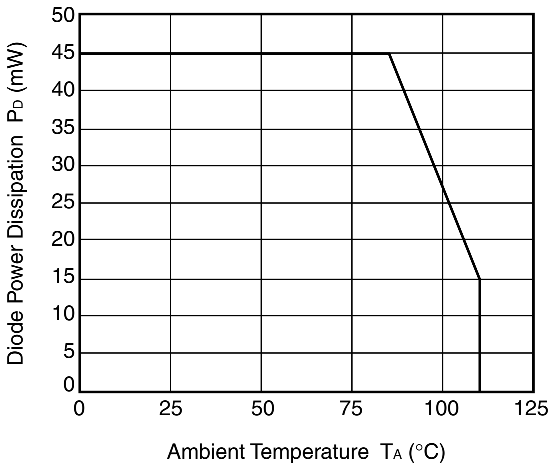


Remarks 1. Common Mode Transient Immunity at High Level Output is the maximum value of dV_{CM}/dt at which the output remains High Level (e.g. $V_O > 26$ V).

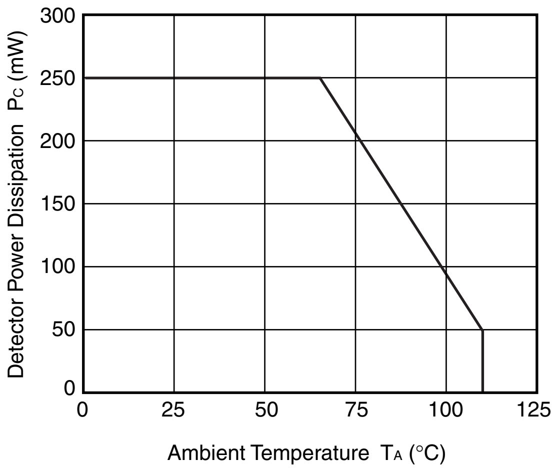
2. Common Mode Transient Immunity at Low Level Output is the maximum value of dV_{CM}/dt at which the output remains Low Level (e.g. $V_O < 1.0$ V).

<R> **TYPICAL CHARACTERISTICS (T_A = 25°C, unless otherwise specified)**

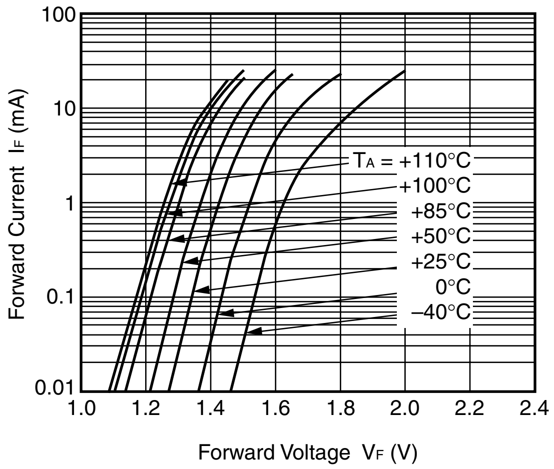
DIODE POWER DISSIPATION vs. AMBIENT TEMPERATURE



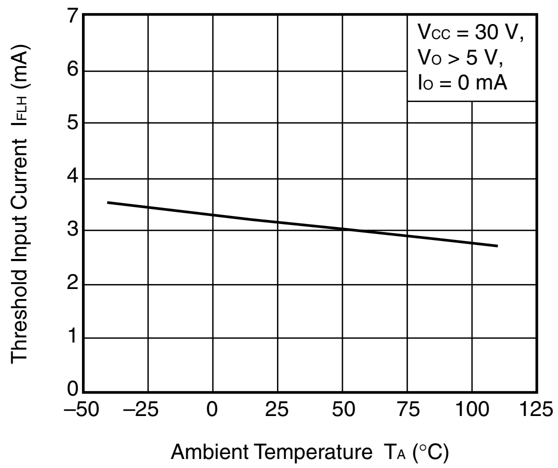
DETECTOR POWER DISSIPATION vs. AMBIENT TEMPERATURE



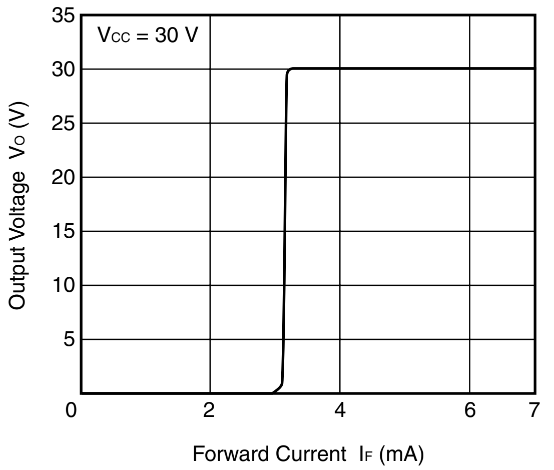
FORWARD CURRENT vs. FORWARD VOLTAGE



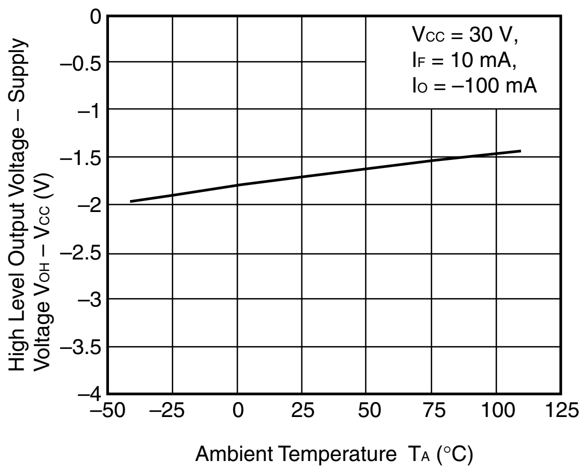
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



OUTPUT VOLTAGE vs. FORWARD CURRENT

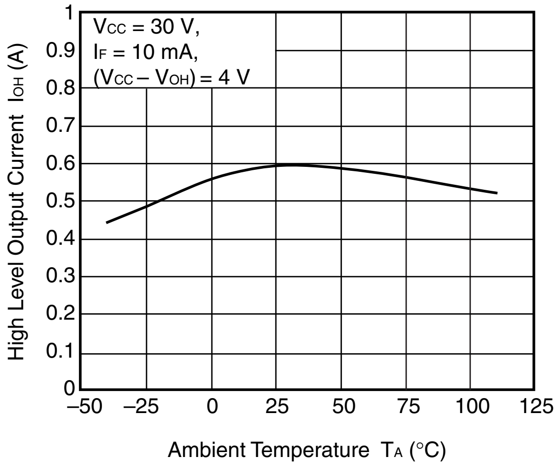


HIGH LEVEL OUTPUT VOLTAGE – SUPPLY VOLTAGE vs. AMBIENT TEMPERATURE

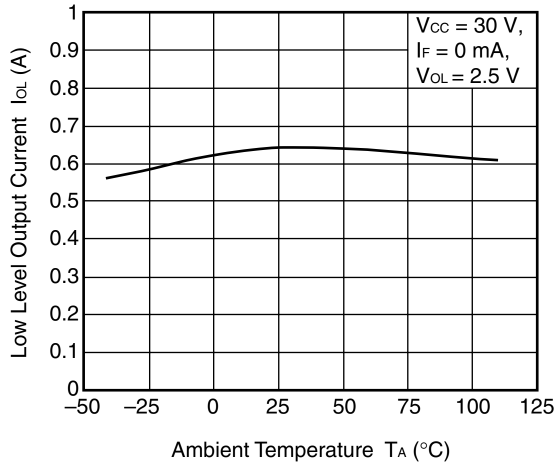


Remark The graphs indicate nominal characteristics.

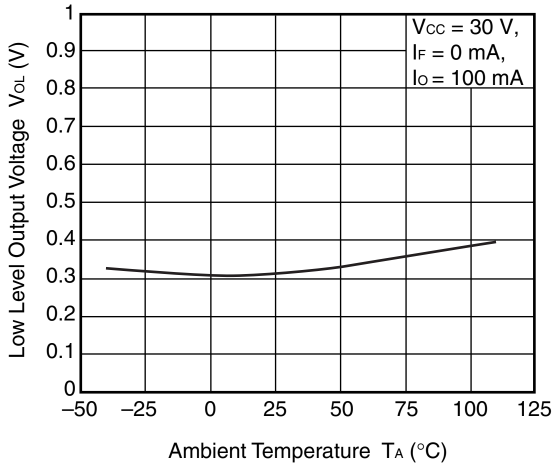
HIGH LEVEL OUTPUT CURRENT vs. AMBIENT TEMPERATURE



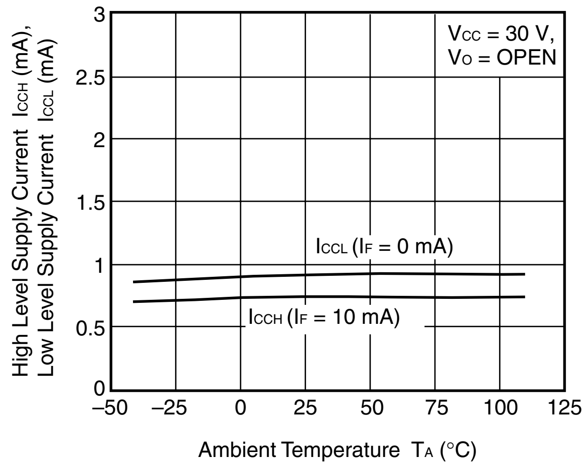
LOW LEVEL OUTPUT CURRENT vs. AMBIENT TEMPERATURE



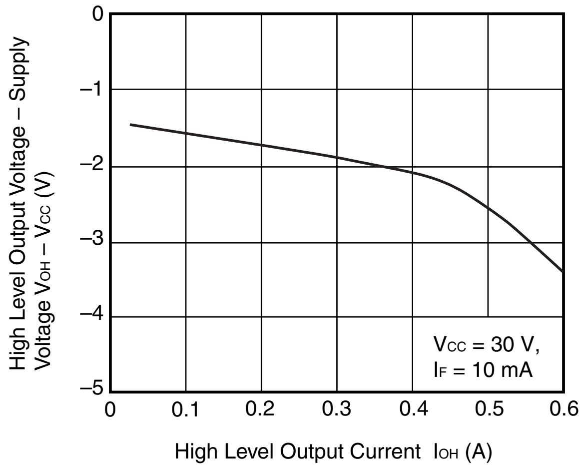
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



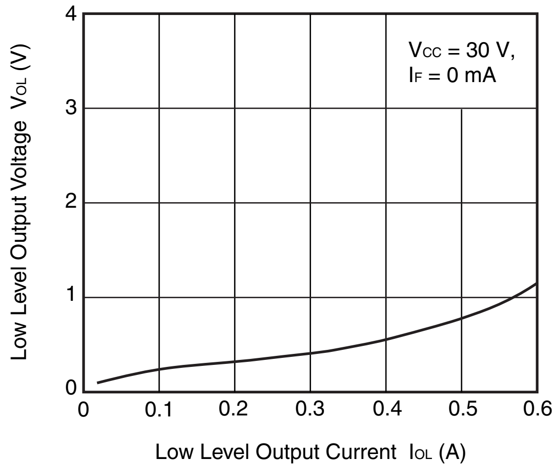
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



HIGH LEVEL OUTPUT VOLTAGE – SUPPLY VOLTAGE vs. HIGH LEVEL OUTPUT CURRENT

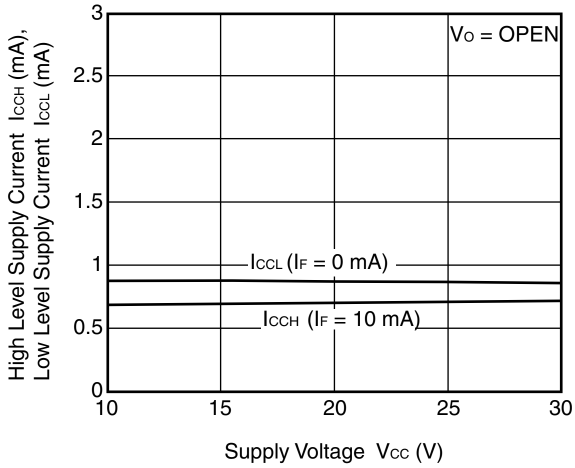


LOW LEVEL OUTPUT VOLTAGE vs. LOW LEVEL OUTPUT CURRENT

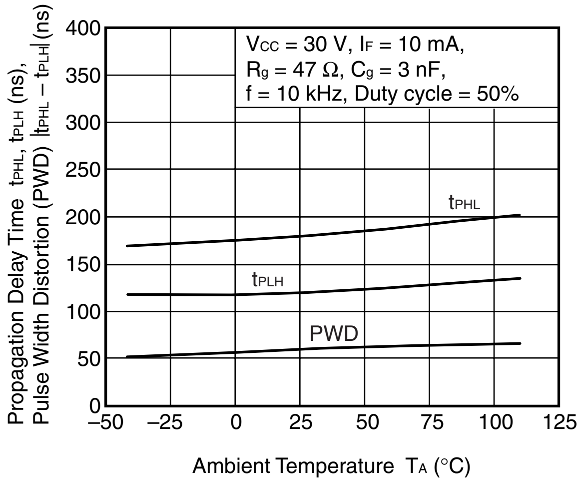


Remark The graphs indicate nominal characteristics.

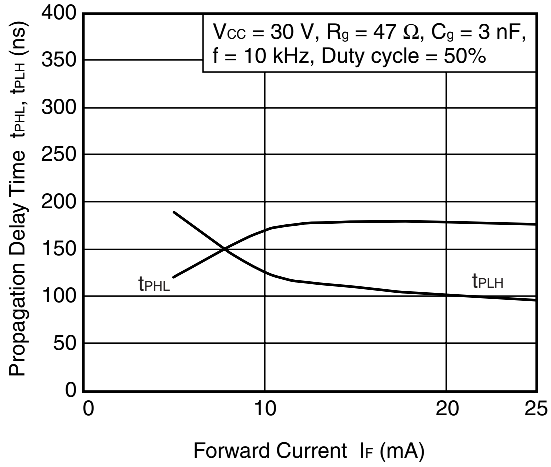
SUPPLY CURRENT vs.
SUPPLY VOLTAGE



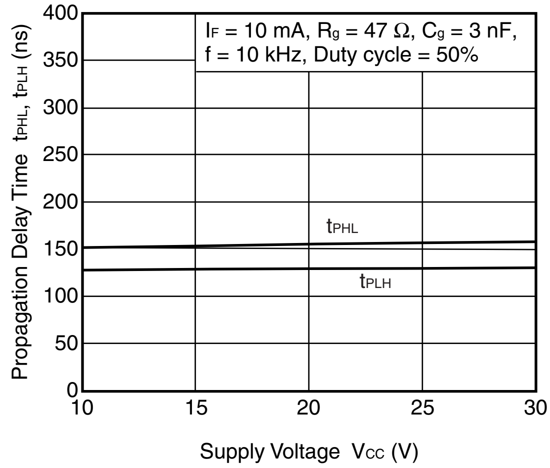
PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. AMBIENT TEMPERATURE



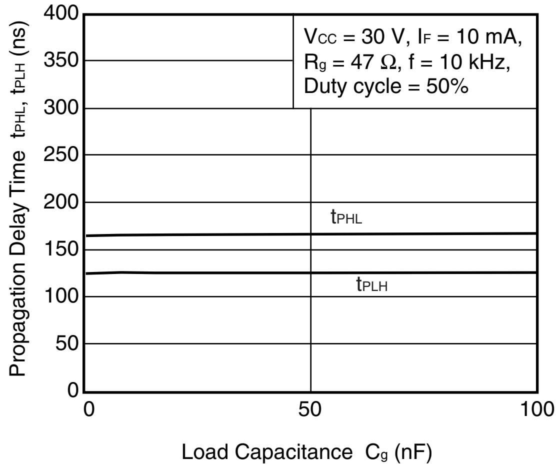
PROPAGATION DELAY TIME vs.
FORWARD CURRENT



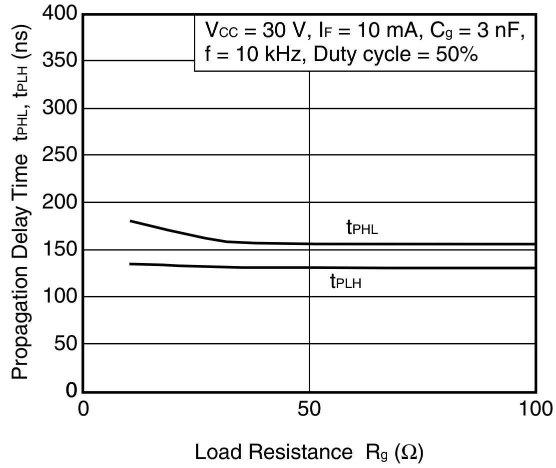
PROPAGATION DELAY TIME vs.
SUPPLY VOLTAGE



PROPAGATION DELAY TIME vs.
LOAD CAPACITANCE



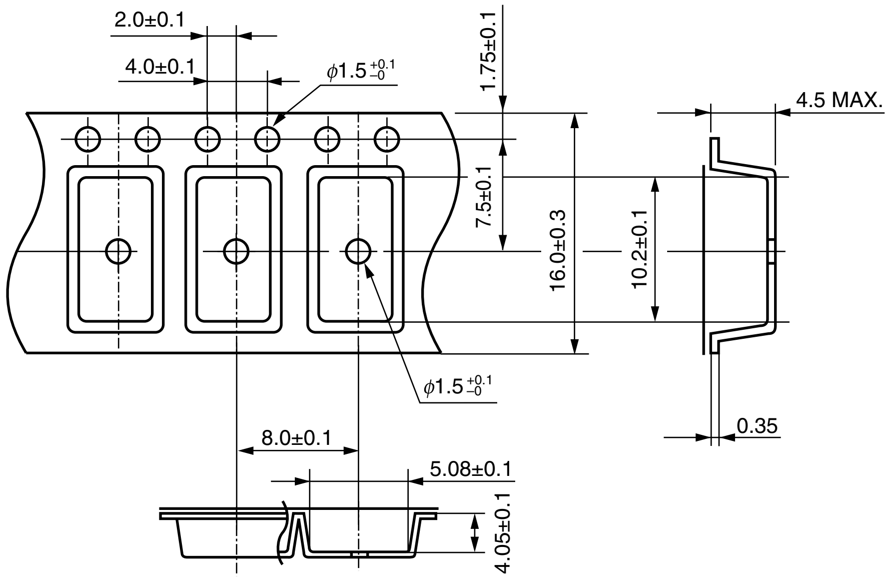
PROPAGATION DELAY TIME
vs. LOAD RESISTANCE



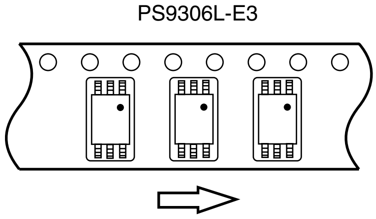
Remark The graphs indicate nominal characteristics.

<R> **TAPING SPECIFICATIONS (UNIT: mm)**

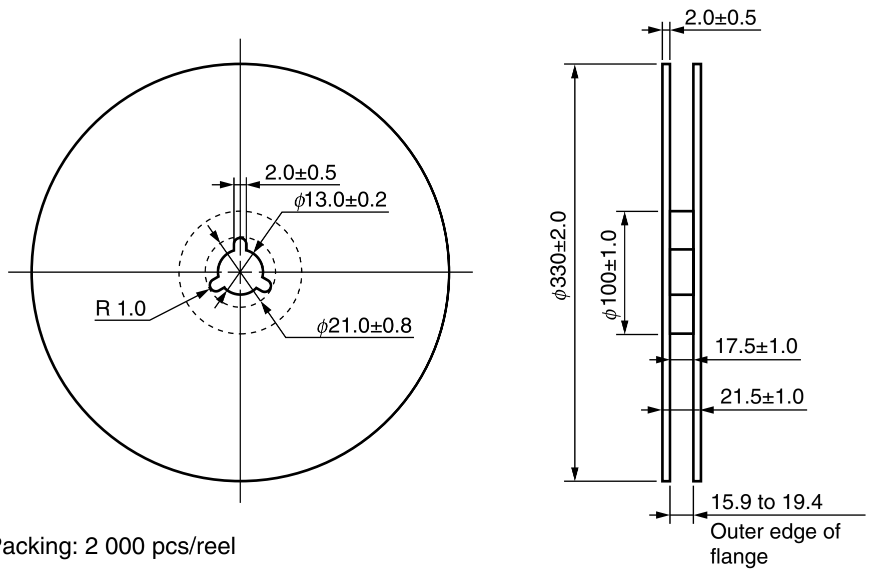
Outline and Dimensions (Tape)



Tape Direction

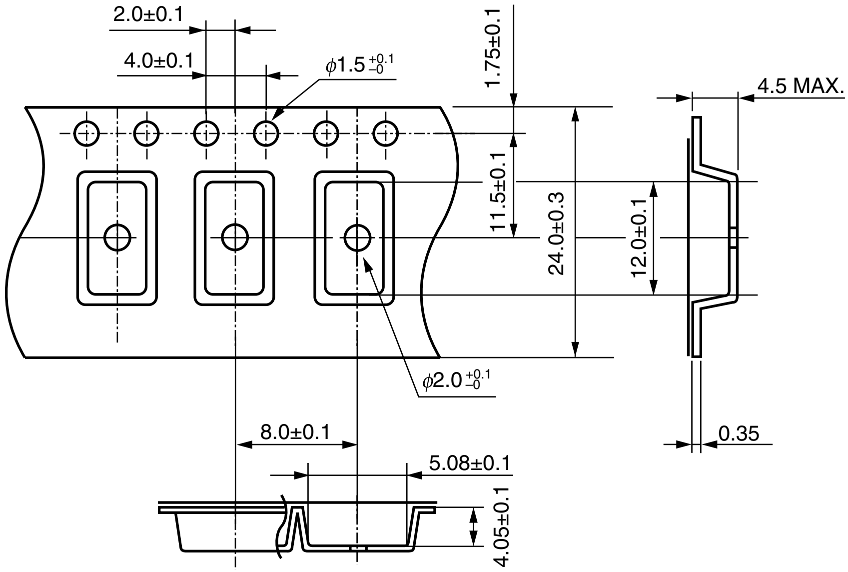


Outline and Dimensions (Reel)

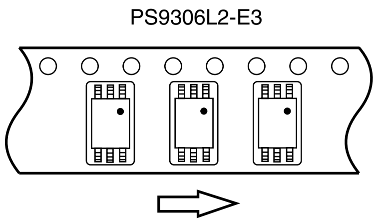


Packing: 2 000 pcs/reel

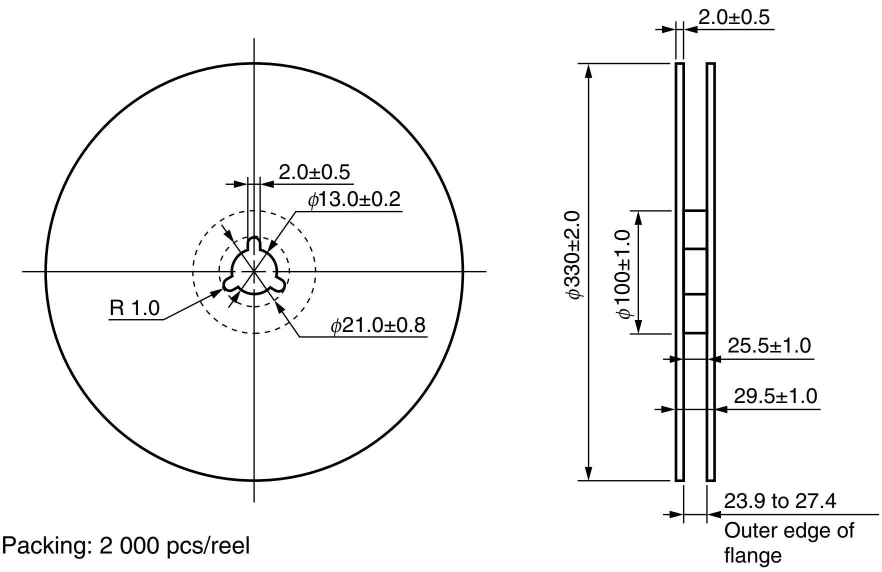
Outline and Dimensions (Tape)



Tape Direction

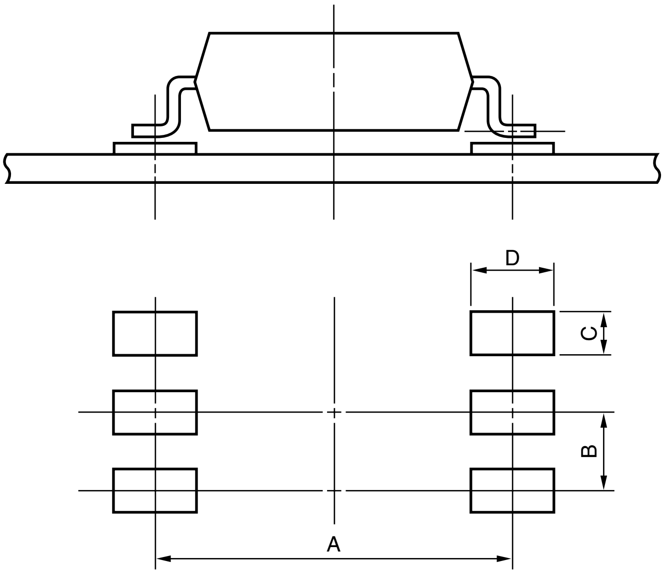


Outline and Dimensions (Reel)



Packing: 2 000 pcs/reel

<R> RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Part Number	Lead Bending	A	B	C	D
PS9306L	lead bending type (Gull-wing) for surface mount	9.2	1.27	0.8	2.2
PS9306L2	lead bending type (Gull-wing) for long creepage distance (surface mount)	10.2	1.27	0.8	2.2

<R>

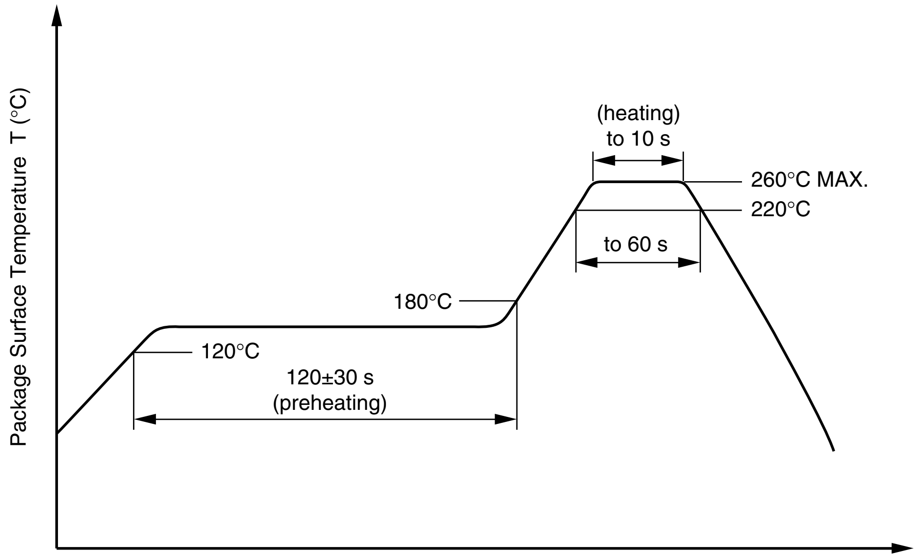
NOTES ON HANDLING

1. Recommended soldering conditions

(1) Infrared reflow soldering

• Peak reflow temperature	260°C or below (package surface temperature)
• Time of peak reflow temperature	10 seconds or less
• Time of temperature higher than 220°C	60 seconds or less
• Time to preheat temperature from 120 to 180°C	120±30 s
• Number of reflows	Three
• Flux	Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

Recommended Temperature Profile of Infrared Reflow



(2) Wave soldering

• Temperature	260°C or below (molten solder temperature)
• Time	10 seconds or less
• Preheating conditions	120°C or below (package surface temperature)
• Number of times	One (Allowed to be dipped in solder including plastic mold portion.)
• Flux	Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

(3) Soldering by Soldering Iron

• Peak Temperature (lead part temperature)	350°C or below
• Time (each pins)	3 seconds or less
• Flux	Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

(a) Soldering of leads should be made at the point 1.5 to 2.0 mm from the root of the lead

(4) Cautions

- Fluxes   Avoid removing the residual flux with freon-based and chlorine-based cleaning solvent.

2. Cautions regarding noise

Be aware that when voltage is applied suddenly between the photocoupler’s input and output at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

<R> USAGE CAUTIONS

1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. Board designing
   (1) By-pass capacitor of more than 0.1 μF is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
   (2) When designing the printed wiring board, ensure that the pattern of the IGBT collectors/emitters is not too close to the input block pattern of the photocoupler.
   If the pattern is too close to the input block and coupling occurs, a sudden fluctuation in the voltage on the IGBT output side might affect the photocoupler's LED input, leading to malfunction or degradation of characteristics. (If the pattern needs to be close to the input block, to prevent the LED from lighting during the off state due to the abovementioned coupling, design the input-side circuit so that the bias of the LED is reversed, within the range of the recommended operating conditions, and be sure to thoroughly evaluate operation.)
   (3) Pin 2 (which is an NC*1 pin) can either be connected directly to the GND pin on the LED side or left open. Unconnected pins should not be used as a bypass for signals or for any other similar purpose because this may degrade the internal noise environment of the device.
   Note: *1. NC: Non-Connection (No Connection).
3. Make sure the rise/fall time of the forward current is 0.5 μs or less.
4. In order to avoid malfunctions, make sure the rise/fall slope of the supply voltage is 3 V/μs or less.
5. Avoid storage at a high temperature and high humidity.

<R> SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Spec.	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/110/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.6 \times U_{IORM}$, $P_d < 5$ pC	 U_{IORM} U_{pr}	 1 130 1 808	 V_{peak} V_{peak}
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM}$, $P_d < 5$ pC	U_{pr}	2 119	V_{peak}
Highest permissible overvoltage	U_{TR}	8 000	V_{peak}
Degree of pollution (DIN EN 60664-1 VDE0110 Part 1)		2	
Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303 Part 11))	CTI	175	
Material group (DIN EN 60664-1 VDE0110 Part 1)		III a	
Storage temperature range	T_{stg}	–55 to +125	°C
Operating temperature range	T_A	–40 to +110	°C
Isolation resistance, minimum value V_{IO} = 500 V dc at T_A = 25°C V_{IO} = 500 V dc at T_A MAX. at least 100°C	 Ris MIN. Ris MIN.	 10^{12} 10^{11}	 Ω Ω
Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve) Package temperature Current (input current I_F, Psi = 0) Power (output or total power dissipation) Isolation resistance V_{IO} = 500 V dc at T_A = Tsi	 Tsi Isi Psi Ris MIN.	 175 400 700 10^9	 °C mA mW Ω

Caution GaAs Products	This product uses gallium arsenide (GaAs). GaAs vapor and powder are hazardous to human health if inhaled or ingested, so please observe the following points. • Follow related laws and ordinances when disposing of the product. If there are no applicable laws and/or ordinances, dispose of the product as recommended below. 1. Commission a disposal company able to (with a license to) collect, transport and dispose of materials that contain arsenic and other such industrial waste materials. 2. Exclude the product from general industrial waste and household garbage, and ensure that the product is controlled (as industrial waste subject to special control) up until final disposal. • Do not burn, destroy, cut, crush, or chemically dissolve the product. • Do not lick the product or in any way allow it to enter the mouth.

Revision History	PS9306L,PS9306L2 Data Sheet

Rev.	Date	Description	
		Page	Summary
0.01	Aug 20, 2010	–	First edition issued
1.00	Nov 10, 2011	Throughout	Preliminary Data Sheet → Data Sheet
		Throughout	Safety standards approved
		p.3	Modification of **MARKING EXAMPLE**
		p.6	Modification of **ELECTRICAL CHARACTERISTICS**
		p.8	Addition of **TEST CIRCUIT Fig. 6**
		p.9	Modification of **TEST CIRCUIT Fig. 7, 8**
		pp.10 to 12	Addition of **TYPICAL CHARACTERISTICS**
		pp.13, 14	Addition of **TAPING SPECIFICATIONS**
		p.15	Addition of **RECOMMENDED MOUNT PAD DIMENSIONS**
		p.16	Modification of **NOTES ON HANDLING**
		p.17	Modification of **USAGE CAUTIONS**
		p.18	Addition of **SPECIFICATION OF VDE MARKS LICENSE DOCUMENT**

SALES OFFICES Renesas Electronics Corporation http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics America Inc.
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-65030, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

Renesas Electronics Hong Kong Limited
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
1 harbourFront Avenue, #06-10, keppel Bay Tower, Singapore 098632
Tel: +65-6213-0200, Fax: +65-6278-8001

Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics Korea Co., Ltd.
11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

Colophon 1.1